SOFTWARE USER MANUAL

PmacPlot

Software User Manual

5xx-09WPRO-xSxx

January 28, 2003

DELTA TAU
Data Systems, Inc.
NEW IDEAS IN MOTION ...

Single Source Machine Control *Power // Flexibility // Ease of Use*
21314 Lassen Street Chatsworth, CA 91311 // Tel. (818) 998-2095 Fax. (818) 998-7807 // www.deltatau.com

License Statement and Limited Warranty

(If you have any questions, contact our Customer Service Department at (818) 998-2095)

IMPORTANT: Carefully read all the terms and conditions of this agreement before installing this software. Installing this software indicates your acceptance of the terms and conditions contained in this agreement. If you do not agree to the terms and conditions contained in this agreement, promptly return this package, unopened, and all associated documentation to the place of purchase, and your money will be refunded. No refunds will be given for products that have missing or damaged components.

LICENSE: This software is protected by the United States copyright law. Therefore, you must treat this software exactly like a book, except that you may copy it onto a computer to be used, and you may make archival copies of the software for the sole purpose of protecting your investment from loss.

By saying, "just like a book," Delta Tau means that this software is free to be used by any number of people and that it may be freely moved from one computer to another so long as it is impossible for it to be used at one location while its also being used at another. Just like a book can not be read by two people in different locations, this software is not permitted to be used by two people in different locations.

Further, you may not download or, by any other means, transmit this software electronically from one computer to another, except as may be specifically allowed in using the software on a computer network (see below). You may transfer all of your rights to use this software to another person, provided that you also transfer all components of this package, including software, diskettes, documentation, and this license agreement, and that you destroy all archival copies and copies installed on a computer for use of this product, including copies in RAM or installed on a disk or diskettes. Remember, once you transfer the software, it may only be used at a single location at a time, as specified in this agreement. At no time may you otherwise transfer, rent, lease, sub-lease, time-share, or lend the software, diskettes, documentation, or any part included herein. Your use of this software is limited to acts that are essential in the use of the software on your computer as described in the documentation. You may not otherwise modify, alter, decompile, or reverse-engineer the software, and you may not remove or obscure Delta Tau's copyright or trademark notices.

NETWORK LICENSE: A "network" is any electronically linked configuration in which two or more users have common access to software or data. Using this software in such a manner is not in accordance with this license agreement, unless you add authorized user licenses as specified below. You may attain additional user licenses by (1)purchasing additional individual software packages for each additional user you wish to add or (2)if a Network Pack is available for this product, paying for the multiple-use license available in the Network Pack. Note that you may use any combination of methods (1) and (2) to increase the number of authorized user licenses.

TERM: This license agreement is in effect until terminated. You may at any time terminate this agreement by destroying the software, diskettes, documentation, and all copies thereof. Delta Tau reserves the right to terminate this agreement if you fail to comply with any of the terms and conditions contained herein. Should Delta Tau terminate this agreement because of your failure to comply, you agree to destroy or return to Delta Tau the program and documentation and any copies, in any and all forms, received from Delta Tau or generated in connection with this agreement.

LIMITED WARRANTY: Delta Tau warrants that the diskettes and documentation enclosed within this product will be free from defects in materials and workmanship for a period of ninety days from the date of purchase as evidenced by a copy of your receipt. THE PROGRAM IS PROVIDED "AS-IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. This limited warranty gives you specific legal rights; you may have others which vary from state to state. Some states do not allow the exclusion of incidental or consequential damages so some of the above may not apply to you.

The entire and exclusive liability and remedy for breach of the Limited Warranty shall be limited to replacement of defective diskette(s) or documentation and shall not include or extend to any claim for or right to recover any other damages, including but not limited to, loss of profit, data, or use of the software, or special, incidental, or consequential damages or other similar claims, even if Delta Tau has been specifically advised of the possibility of such damages. In no event will Delta Tau's liability for damages to you or any other person ever exceed the actual original price paid, as evidenced by the receipt, for the license to use the software, regardless of any form of the claim. In the event that the original receipt is lost, the suggested list price at the time of purchase will be substituted as the maximum amount for liability for damages.

GOVERNMENT: This license statement shall be construed, interpreted, and governed by the laws of the State of California. If any provision of this statement is found void or unenforceable, it will not effect the validity of the balance of this statement, which shall remain valid and enforceable according to its terms. If any remedy provided is determined to have failed of its essential purpose, all limitations of liability and exclusions of damages set forth in the Limited Warranty shall remain in full force and effect. This statement may only be modified in writing signed by you and an authorized officer of Delta Tau. Use, duplication, or disclosure by the US Government of the computer software and documentation in this package shall be subject to the restricted rights applicable to commercial computer software. All rights not specifically granted in this statement are reserved by Delta Tau.

Delta Tau Data Systems, Inc. 9036 Winnetka Street, Northridge CA. 91324 (818) 998-2095

All Delta Tau products are trademarks of Delta Tau. Copyright ©1995, 1996 Delta Tau. All right reserved.

Table of Contents

GETTING STARTED **1**
What's New with PMAC Plot 1.19 1
Installation 1
Command Line Parameter 1

QUICKPLOT **3**
QuickPlot 3
Plot Title *3*
Motors to Gather *3*
Define Gather Buffer *4*
Begin Gathering *4*
End Gathering *4*
Upload Data *4*
Possible Choices *4*
Add to Left *5*
Add to Right *5*
Left Plot Axis *5*
Right Plot Axis *5*
Remove Item *5*
Horizontal Axis *5*
Plot Data *5*
Open *6*
Exit *6*
Saving and Loading Gathered Data 6
A Typical Quick Plotting Scenario 6

DETAIL PLOT **7**
Detail Plot 7
Items to Gather 8
Specify a Variable to Gather (>>) *8*
Scaling and Processing 9
Scaling and Processing for One Item *10*
Scaling and Processing for Two Items *11*
Items to Plot 12
Configure a Plot Dialog Box *12*
Define Gather, Begin Gather, End Gather 13
Upload Data 13
Plot Data 13
Others 13
Saving and Loading Gathered Data 14

PLOT WINDOWS **15**
Plot Window 15
Tools 16
Data Editor *16*
Change PmacPlot Option 17
Scale *17*
Series *17*
Save Plot Files 18
Save Plot Data into PPL-File *18*
Save Plot Data into a Text File and Recreate the Plot from Microsoft Excel *18*
Save Plot Data into a Matlab File (M-file) *18*
FFT (Fast Fourier Transform) 19
Frequency Range *19*
Logarithmic Plot *19*

USING SIMULATED MODE **21**

GETTING STARTED

What's New with PMAC Plot 1.19

There are numerous new features implemented in PMAC Plot Release 1.19 Software.

- FFT Conversion for quick or detailed plot
- Saving gathered data in quick or detailed plot
- Simulation mode
- Different default plot color for ease of printing

Using these new features is intuitive but for users interested in knowing more about them, more information is provided in the following.

Installation

Run the Setup.Exe application on Disk #1 of this distribution. This will place all required files in the appropriate locations on your system.

The default location for PmacPlot is C:\Program Files\Delta Tau\PmacPlot.

We suggest you reboot your system at the end of the installation process.

Command Line Parameter

PmacPlot is a 32-bit application separate from PEWIN32. PmacPlot can be launched from a PEWIN32 menu item. PmacPlot can be run by itself.

If PmacPlot is run alone, use the PMAC device number as a command line argument.

Example: Assume there are two PMACs in the system: the first PMAC is device 0, and the second PMAC is device 1. To talk to the first PMAC, run PmacPlot as follows:

```
C:\Program Files\Delta Tau\PmacPlot\PmacPlot.exe 0
```

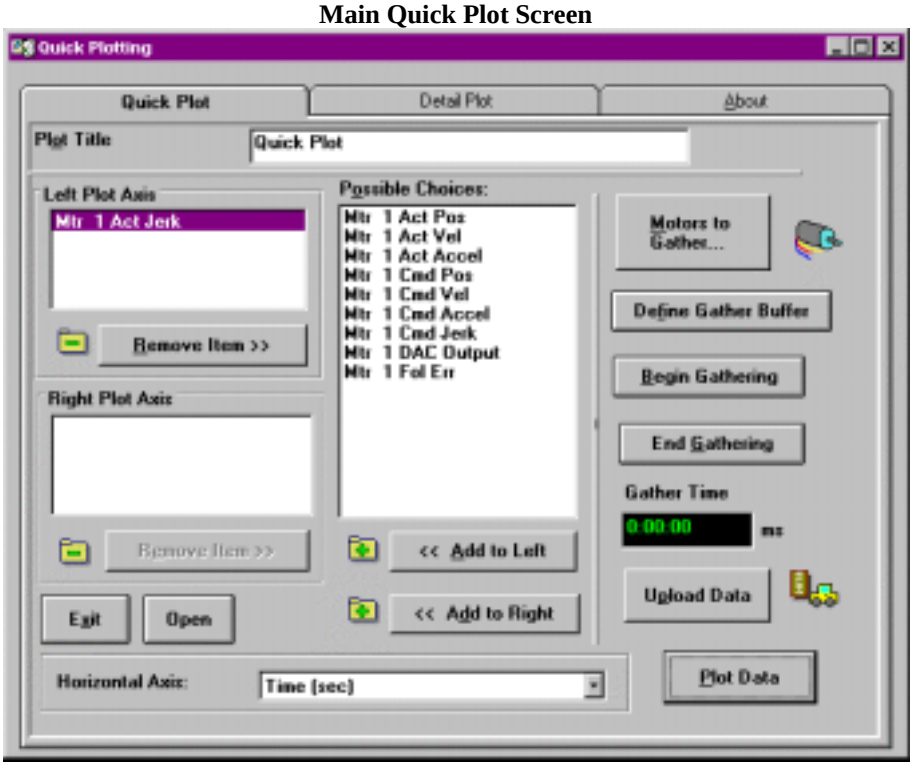
The method of communication is determined by the settings of Motion Applet. If you want to switch from PC-bus communication to serial port communication, you need to change the settings in Motion Applet and then launch PmacPlot.

QUICKPLOT

QuickPlot

The quick plotting dialog box makes data acquisition and presentation easy. It is not required to know any PMAC memory locations to gather or how to plot some common motor parameters. A few simple menus and buttons control the address mapping.

Main Quick Plot Screen



Plot Title

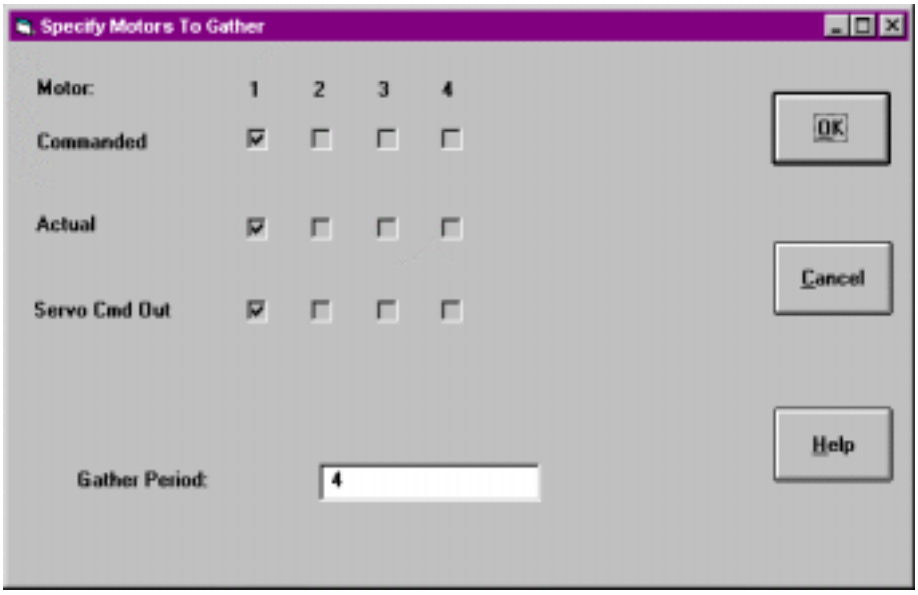
In this field, a title can be given to a plot. This title will appear above the plot.

Motors to Gather

Click this button to open a window to select what information will be collected and for which motors. Commanded encoder values, actual encoder values, and servo command output can be commanded for up to eight motors. The servo command output is DAC output for PMAC and current quadrature for PMAC2. A check mark indicates to gather data for that item.

Specify the Gather Period (I19), which tells PMAC how often to collect data from the selected items. The units for the gather period are in servo cycles. With PMAC in its default jumper setting for the servo interrupt, 1 servo cycle is equivalent to 440 μsec. Thus, if the Gather Period should be 1, data will be gathered every 440 μsec. If the entered Gather Period is zero or negative, the PmacPlot will give a warning and prompt for a reasonable value.

The number of motors displayed in this window depends on the type of PMAC in the system. If there is an 8-axis controller PMAC in the system, there will be eight motors shown in this window.



Define Gather Buffer

After the motors to gather data for have been selected, click this button to set up the appropriate PMAC I-Variables for data gathering.

> ***Note:***
>
> Data cannot be gathered until this button is clicked.

Begin Gathering

When ready to start gathering data, click this button. The amount of elapsed time is displayed in the **Gather Time** field.

End Gathering

When enough data has been gathered, click this button to stop data gathering. The **Gather Time** field will stop changing. At this point, the data can be uploaded.

Upload Data

Once data has been gathered, click this button to upload the existing gathered data from PMAC's memory into the PC's memory.

Possible Choices

Before plotting the data, specify what items to see on the plot. Highlight items in the **Possible choice** field and move them to the Left Plot Axis or Right Plot Axis fields.

> ***Note:***
>
> There must be at least one selected item to be plotted. Up to four items may be plotted against each vertical plot axis.

The motors selected to gather data for determine which items can be selected to plot.

Example:
If specifying to gather data for motor #1's actual position only, only motor #1's actual position, actual velocity (1st time derivative of position), actual acceleration (2nd derivative), or actual jerk (3rd derivative) may be plotted. In this example, commanded position, velocity, etc. cannot be plotted because data has only been gathered for motor #1's actual position. To plot the following error for motor #1, gather data on motor #1's actual and commanded position since following error is defined as the difference between the two.

Add to Left

This button adds the selected item from **Possible Choices** field to the left plot axis.

Note:

Up to four items can be added. This means that only four items can be plotted against the left plot axis. A total of eight items can be plotted with four items per vertical axis at a time.

Add to Right

This button adds the selected item from **Possible Choices** field to the right plot axis.

Note:

Up to four items can be added. This means that only four items can be plotted against the right plot axis. A total of eight items can be plotted with four items per vertical axis at a time.

Left Plot Axis

This field lists the items to be displayed on the left plot axis. There can be up to four items plotted against the left plot axis.

Note:

Up to eight items, four items per vertical axis may be plotted at a time.

Right Plot Axis

This field lists the items to be displayed on the right plot axis. There can be up to four items plotted against the right plot axis.

Note:

Up to eight items, four items per vertical axis may be plotted at a time.

Remove Item

This button removes the selected item from the plot axis.

Note::

There must be at least one item on the left plot.

Horizontal Axis

Use this list box to specify what item is to be plotted on the horizontal axis. In most cases, the horizontal axis is Time. However, other items can be chosen as horizontal axis.

Example: Choose one motor's commanded position as vertical axis and another motor's commanded position as horizontal axis.

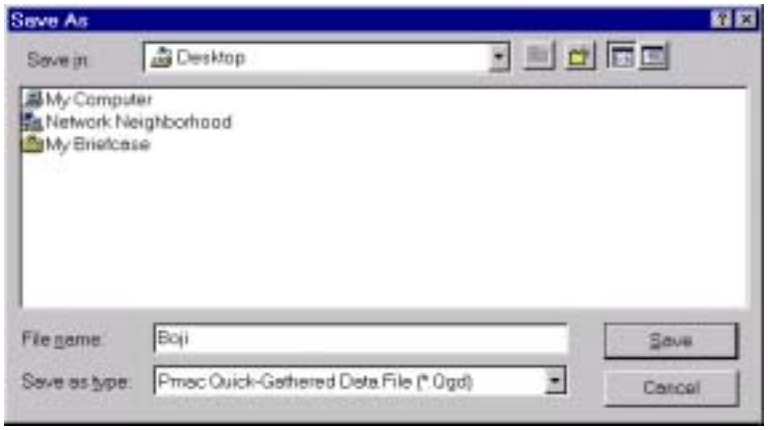
Plot Data

Click this button to view the plot just created. This plot window can be resized and the plot will rescale itself to fit within the new sized window automatically. See the Plot Windows section below for more information on plot windows.

Open
This command button opens the previously saved plot file (PPL-file).

Exit
This command button saves the current settings of the configurations automatically (both QuickPlot and DetailPlot) and exits the PmacPlot program.

Saving and Loading Gathered Data
In addition to PPL files, now PMAC Plot can save the gathered data in both quick plot and detailed plot. From the Save menu, select **Gathered Data**, and a save screen will open to save the file into a .Qgd file



Likewise, to upload a saved gathered data, choose **Open Menu**, then choose **Gathered Data** from the **File** menu. The saved data can be uploaded from a similar window as above.

A Typical Quick Plotting Scenario
Goal: To analyze the DAC output for motor #1 and #3 during program execution.

Launch the QP (Quick Plot) interface and select the **Motors to Gather** button. From the motors to gather interface window, select **DAC**, **Actual** and **Commanded** fields for motor #1 and motor #3 and click the **OK** button.

In the QP interface window, click the **Define Gather** button to set up PMAC for data gathering.

Now, click the mouse on the Terminal window of PEWIN executive, start the desired program and click back to the QP interface.

When the program reaches the point wanted to analyze, the click the **Begin Gathering** button to start gathering data.

After a suitable amount of time that the program has been running, click the **End Gathering** button to stop PMAC's data gathering function.

Note:

At this point the program is still running. To abort the program, click on the PEWIN Terminal window and press **^A**.

Click the **Upload Data** button to copy the gathered data from PMAC to the PC.

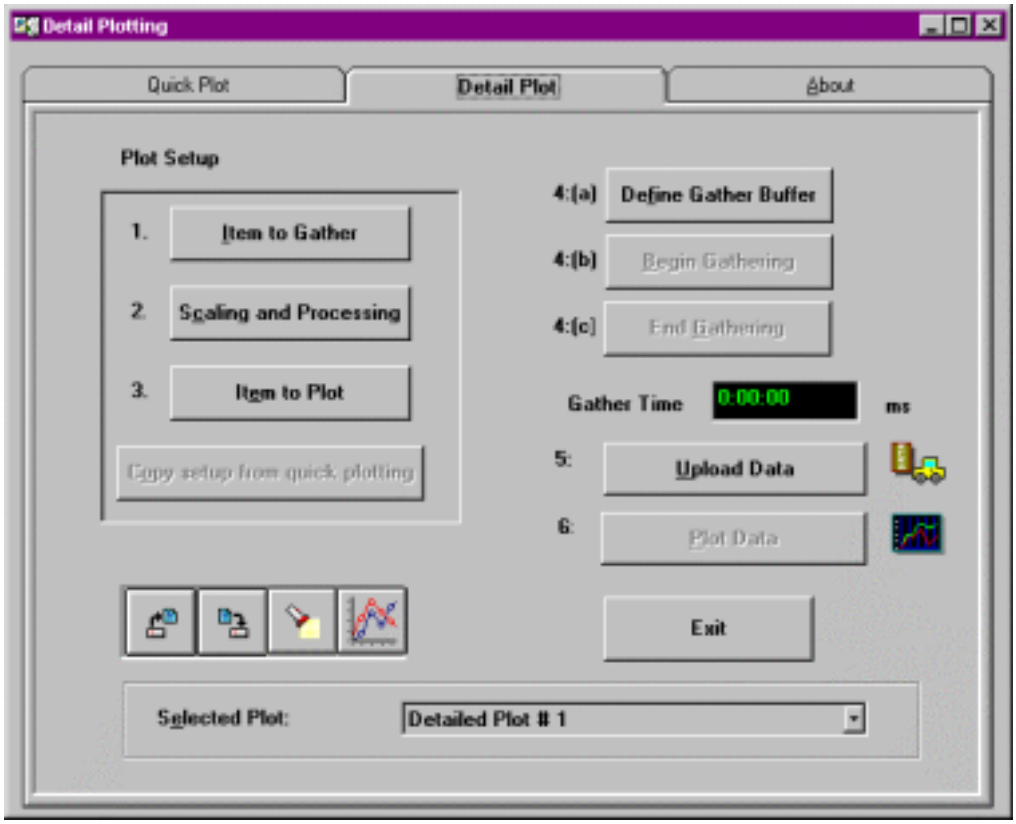
At this point, all the data needed for the analysis is available. Now, configure and display the plots.

DETAIL PLOT

Detail Plot

In contrast to quick plotting (which allows plotting position, velocity, acceleration, jerk, and command output for one or more motors), detailed plotting gives much more control and flexibility over how the plots look and what information they contain. By using detailed plotting, plots can be generated that also contain I/O bits, various internal registers (such as status registers, A/D registers from PMAC accessory boards, etc.), DPRAM registers, M-, P- and Q-variables, and virtually anything in PMAC's memory. This powerful tool is recommended for those who have some experience with quick plotting and are familiar with PMAC's memory map.

Main Detailed Plot Screen



The basic steps needed to create a detailed plot are:

1. Specify the addresses for PMAC to gather (called sources). There are a total of 24 sources that can be specified and gathered (these pertain to PMAC I-variables I21 through I44).
2. Specify how these sources are to be scaled and processed (i.e. whether a source is to be differentiated (to obtain velocity, acceleration, etc.) or to be bit-masked and so on. These processed sources are called items. There are a total of 24 items.
3. Specify which items (i.e. plot curves) are to be included on a plot (for example, items 1 and 2: commanded and actual position for motor #1). On any given plot, there can be up to four items (or curves) – two for the left vertical axis and two for the right vertical axis. There are a total of 26 plots.

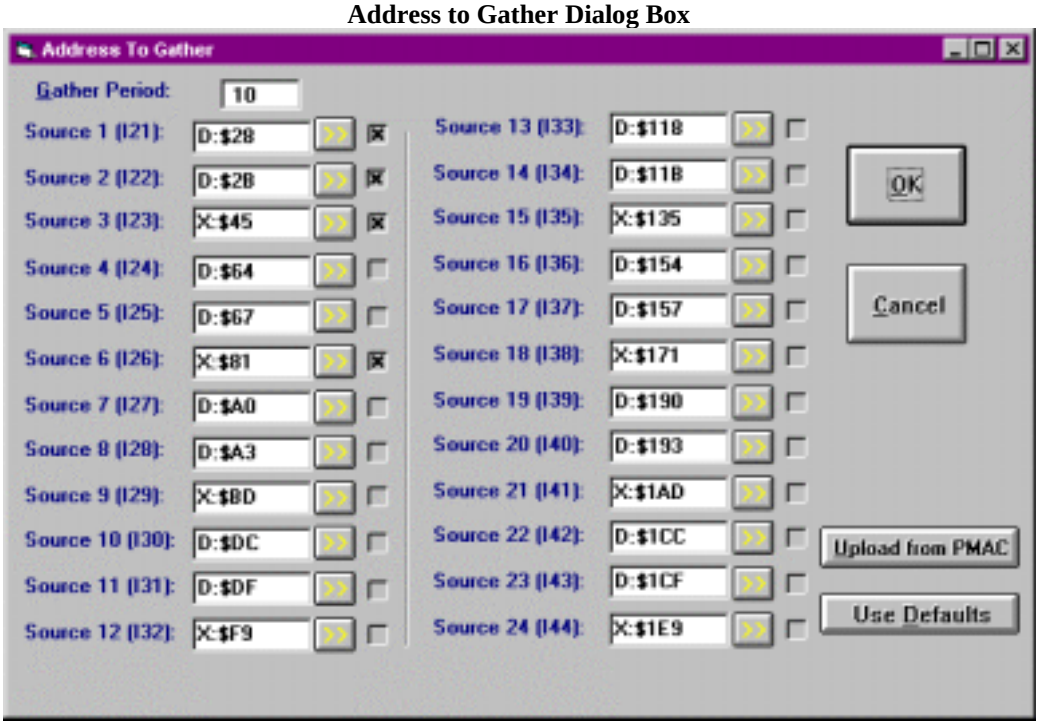
4. Proceed to initiate data gathering on PMAC by using the **DEFINE GATHER**, **GATHER** and **END GATHER** commands. Use these as on-line commands, or include both the **GATHER** and **END GATHER** commands in the motion/PLC programs (i.e. **CMD "GATHER"** and **CMD "END GATHER"**).

5. Upload the gathered data into the Executive and plot the results.

Items to Gather

Use this window to specify what PMAC addresses are to be gathered. These addresses are referred to as gather sources. There are a total of 24 sources. PMAC can be instructed to gather all 24 at the same time.

Address to Gather Dialog Box



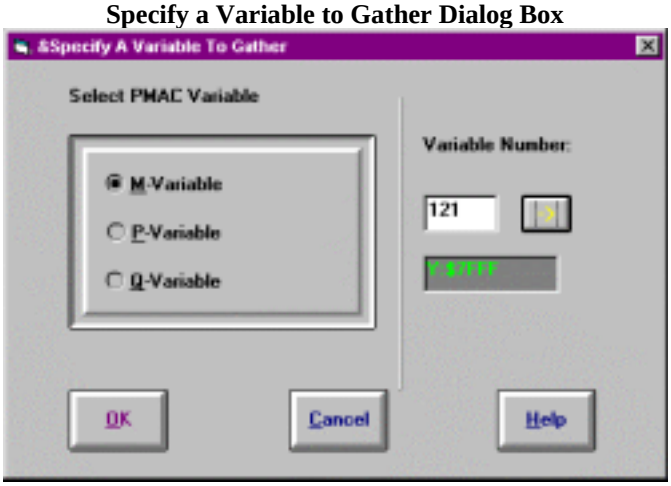
In this window, specify the Gather Period (I19), which tells PMAC how often to collect data from the selected sources. The units for the gather period are in servo cycles. With PMAC in its default jumper setting for the servo interrupt, 1 servo cycle is equivalent to 440 μsec. The specified Gather Period must be greater than zero. There are 24 input fields (labeled as source #1 through #24). Type any valid PMAC address (X, Y, L, D, DP, or F -type addresses). A cross mark placed by the corresponding source field indicates what source will be gathered.

Specify a Variable to Gather (>>)

Next to each address field is a button labeled with a >> mark. Clicking this button opens up a small dialog box, used to specify an M-, P-, or Q- variable to gather. When the **OK** button is clicked, the address of the variable selected is then copied into the corresponding source field. This feature allows easy specification of gathering a PMAC variable without having to look up its address in PMAC's memory map.

Example: To gather M-variable 121, select the M-variable and enter 121 as the variable number. Or click on -> to check which address the M121 points to.

Specify a Variable to Gather Dialog Box



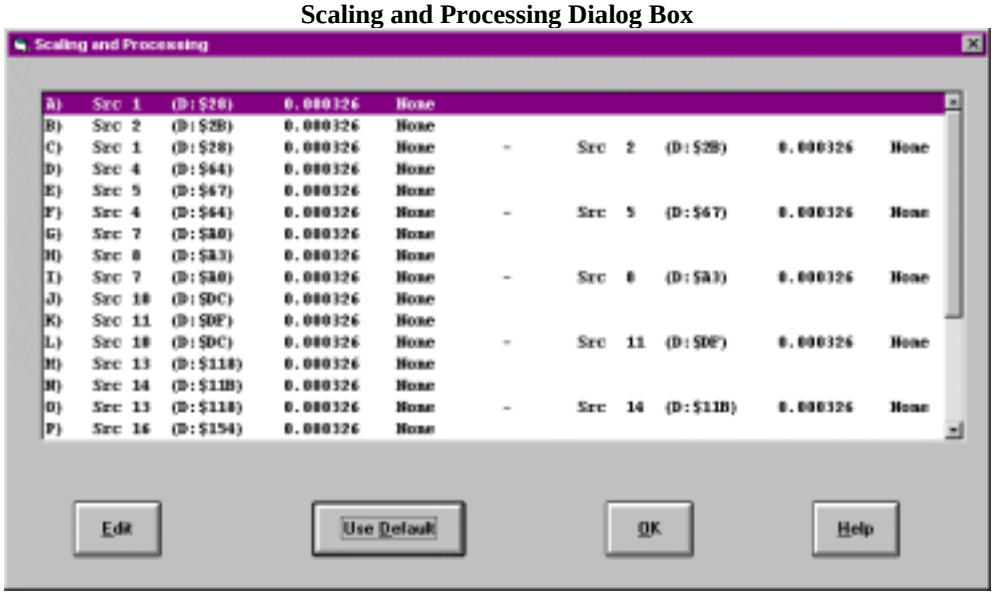
To save the sources specified to a file on a disk, click the **Save to disk** button. Conversely, a set of sources may be loaded from a disk by clicking the **Load from disk** button. Upload the gather sources from PMAC's memory (I-variables I21 through I44) by clicking the **Upload from PMAC** button. Lastly, clicking the **Use defaults** button will copy default addresses into all source fields. Remember that when **OK** is clicked, the specified sources will be sent to PMAC immediately (I-variables I19 through I44).

Scaling and Processing

Use this window to specify how to scale and process a source. These processed sources are referred to as items. Many times it becomes necessary to scale the values gathered by PMAC.

Example: If gathering a position register for a motor, to obtain data in units of encoder counts, take the raw gathered position value, and divide by: 32 * Ix08 (where x is the motor number). The default value for Ix08 is 96, so divide the raw gathered value by 32 * 96 or 3072. Since the PmacPlot will always multiply the scale factor specified, multiply by 0.0003256 (which is the same thing).

Scaling and Processing Dialog Box


Scaling and Processing
A) Src 1 (D:$28) 0.000326 None
B) Src 2 (D:$2B) 0.000326 None
C) Src 1 (D:$28) 0.000326 None - Src 2 (D:$2B) 0.000326 None
D) Src 4 (D:$64) 0.000326 None
E) Src 5 (D:$67) 0.000326 None
F) Src 4 (D:$64) 0.000326 None - Src 5 (D:$67) 0.000326 None
G) Src 7 (D:$A0) 0.000326 None
H) Src 8 (D:$A3) 0.000326 None
I) Src 7 (D:$A0) 0.000326 None - Src 8 (D:$A3) 0.000326 None
J) Src 10 (D:$DC) 0.000326 None
K) Src 11 (D:$DF) 0.000326 None
L) Src 10 (D:$DC) 0.000326 None - Src 11 (D:$DF) 0.000326 None
M) Src 13 (D:$118) 0.000326 None
N) Src 14 (D:$11B) 0.000326 None
O) Src 13 (D:$118) 0.000326 None - Src 14 (D:$11B) 0.000326 None
P) Src 16 (D:$154) 0.000326 None
Edit
Use Default
OK
Help

Select one of the 24 items (labeled A through X) by double clicking it with the mouse, or highlighting it and clicking the **Edit** button. A second dialog box will appear:

Scaling and Processing for One Item

Scaling and Processing Dialog Box for one Item

Item Name

This field contains the name or title of the item, as it will appear in the legend of the plot.

Units

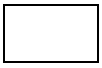
This field contains the units of the item, as it will appear in the legend of the plot.

Source

This list box allows you to choose the source you wish to use for this item. Your choices are from Source 1 to Source 24. The previously specified address of the selected source is shown in parenthesis. If the source is shown with an asterisk next to it, this indicates that the source has not been selected to be gathered.

Scale Factor

This field contains the scale factor that will be used to multiply the raw data samples from the specified source. When plotting position, velocity, acceleration or jerk in units of counts, this scale factor will need to be set to:



The default value for I*x*08 is 96. Therefore, this scale factor is equal to 1 / (32*96) or 0.000326. If your selected source is something other than position, velocity, acceleration or jerk, the scale factor will be different (usually 1).

Differentiate

Use this list box to specify whether or not the source samples are to be differentiated. Differentiation is used commonly for deriving velocity (Once), acceleration (Twice), and jerk (Three times). In most cases, this will be set to None.

Bit masking

A source may be specified to be bit-masked with a value. Often this technique is used to plot the values of certain bits in a number. Click the **Use bit mask** button to enter a value for the bit mask (hexadecimal values must be preceded with a $).

Note:

The Source address for bit masking has to be 24 bit (X or Y). Also check the **Shift result to LSB** checkbox to shift the bits of the masked result to the right. The value in the source will be treated as an unsigned data. The mask cannot be more than seven digits in hexadecimal value.

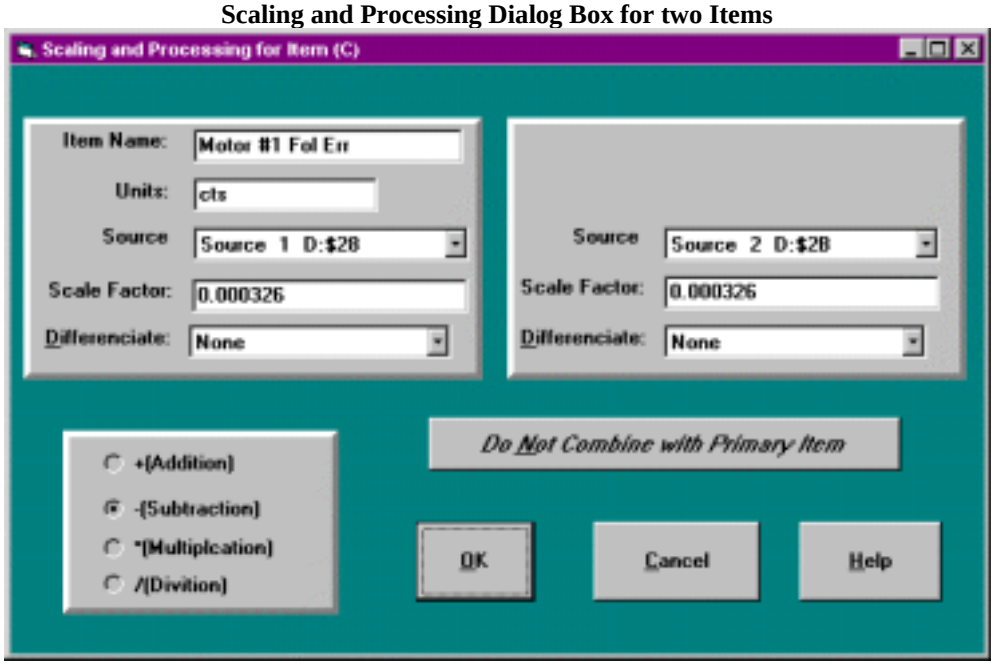
Combine above with a Second Source

Selecting this button opens a different dialog box where two scaled sources can be combined. Commonly this is used for items like following error, where the difference of two sources (command position and actual position) needs to be calculated and plotted.

Scaling and Processing for Two Items

The dialog box allows the implementation of a mathematical operation on any two gathered sources. Commonly this is used for items like following error, where the difference of two sources (command position and actual position) needs to be calculated and plotted.

Scaling and Processing Dialog Box for two Items



The items in this dialog box function the same as in the previously described dialog box. Two sources and two scale factors must be specified.

Combining Operation

Use this operation to specify how the two sources will be combined. This operation is performed after the individual sources are scaled.

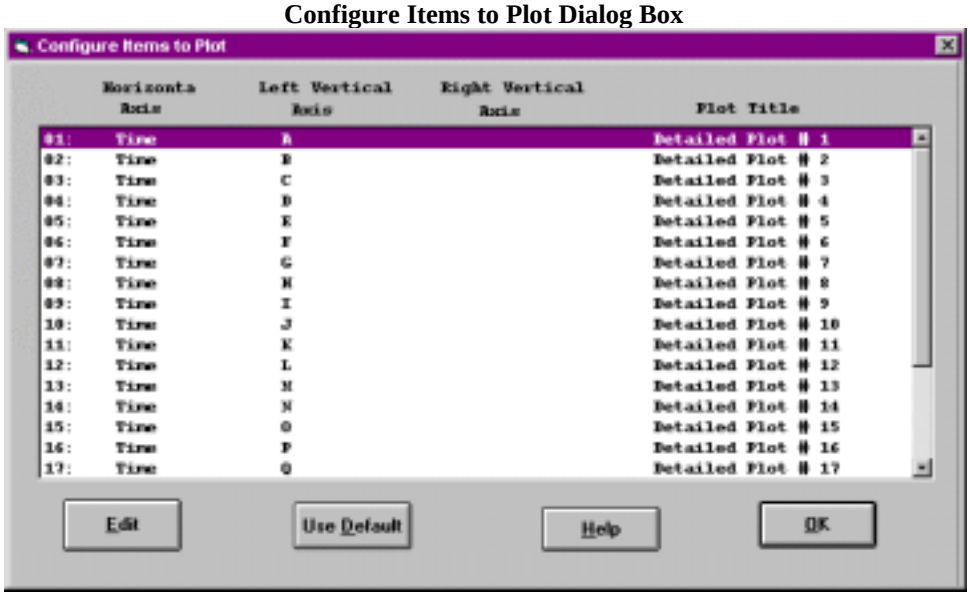
Do not Combine with Primary Item

Clicking this button opens the previous dialog box where only one source is used instead of combining two sources.

Items to Plot

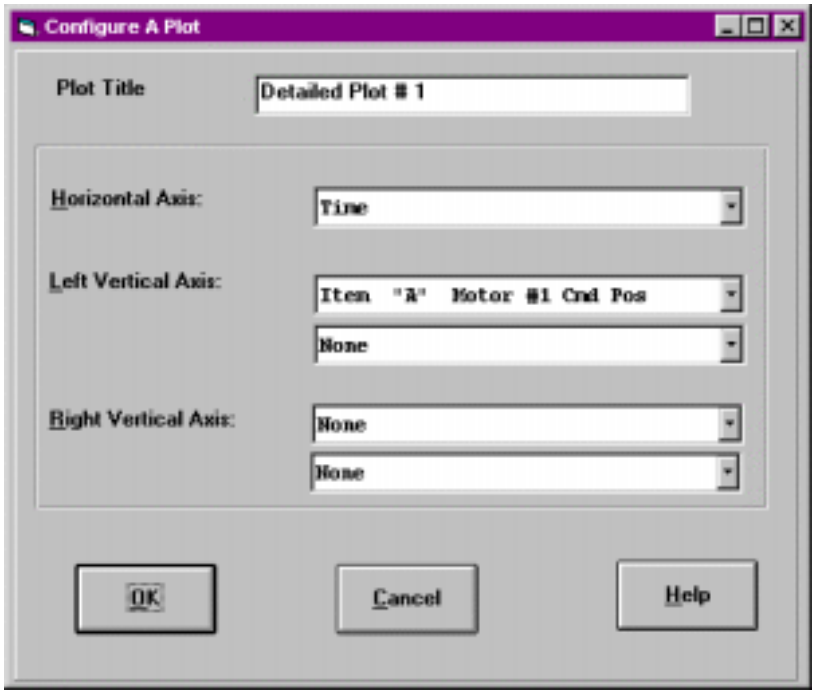
Use this dialog box to specify which of the scaled and processing items are to be used for plotting. Up to 24 plots may be specified. Each plot may contain up to four plot items.

Configure Items to Plot Dialog Box


Configure Items to Plot
Horizonta Axis
Left Vertical Axis
Right Vertical Axis
Plot Title
01: Time A Detailed Plot # 1
02: Time B Detailed Plot # 2
03: Time C Detailed Plot # 3
04: Time D Detailed Plot # 4
05: Time E Detailed Plot # 5
06: Time F Detailed Plot # 6
07: Time G Detailed Plot # 7
08: Time H Detailed Plot # 8
09: Time I Detailed Plot # 9
10: Time J Detailed Plot # 10
11: Time K Detailed Plot # 11
12: Time L Detailed Plot # 12
13: Time M Detailed Plot # 13
14: Time N Detailed Plot # 14
15: Time O Detailed Plot # 15
16: Time P Detailed Plot # 16
17: Time Q Detailed Plot # 17
Edit
Use Default
Help
OK

Select one of the 24 plots (labeled A through X) by double clicking on it, or by highlighting it and clicking the **Edit** button. A second dialog box will appear:

Configure a Plot Dialog Box



Plot Title

Use this entry field to specify the plot title as it appears at the top of the finished plot.

Horizontal Axis

Use this list box to specify what item is to be plotted on the horizontal axis. In most cases, Time will be plotted. However, a plot may be generated where one item is plotted (on the horizontal axis) versus another item (on either the left or right vertical axis).

Example: If data gathering a program that commands two motors to move in a circle, plotting each motor versus time will result in sine wave plots. If one motor is plotted versus the other (by specifying one of the motors to be on the horizontal axis), the plot will yield a circle. To have advanced stability analysis, create a phase plane with following error as horizontal axis and its derivative as vertical axis.

Left Vertical Axis

Use this list box to specify what items are to be plotted on the left vertical axis. Specify at least one item (and may specify up to two items). If only one item is desired, select **None** for the second list box.

Right Vertical Axis

Use this list box to specify what items are to be plotted on the right vertical axis. Up to two items may be specified. If only one item is desired, select **None** for the second list box. If no items are to be plotted, select **None** for both list boxes.

Define Gather, Begin Gather, End Gather

Use these buttons to issue all of the necessary commands to initiate data gathering (by using the **`DEFINE GATHER`**, **`GATHER`** and **`END GATHER`** commands). They can also be issued from the terminal window.

Upload Data

This button uploads gathered data from PMAC into the PmacPlot program prior to plotting.

Plot Data

This button plots the data specified in the **Select Plot** list box. Make a different number of plots in the **Select Plot** list box without reloading the data.

Others

Save to Disk

Use this function to save all detailed plotting configuration information to disk for later retrieval.

Load from Disk

Use this function to load a previously detailed plotting configuration file.

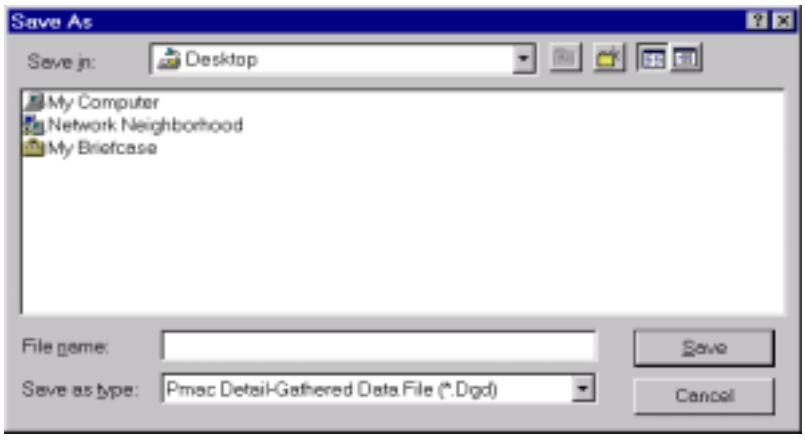
Open

Use this function to open a previously saved plot file (PPL-file).

Exit

This command button automatically saves the current settings of the configurations (both QuickPlot and DetailPlot) and exits the PmacPlot program.

Saving and Loading Gathered Data



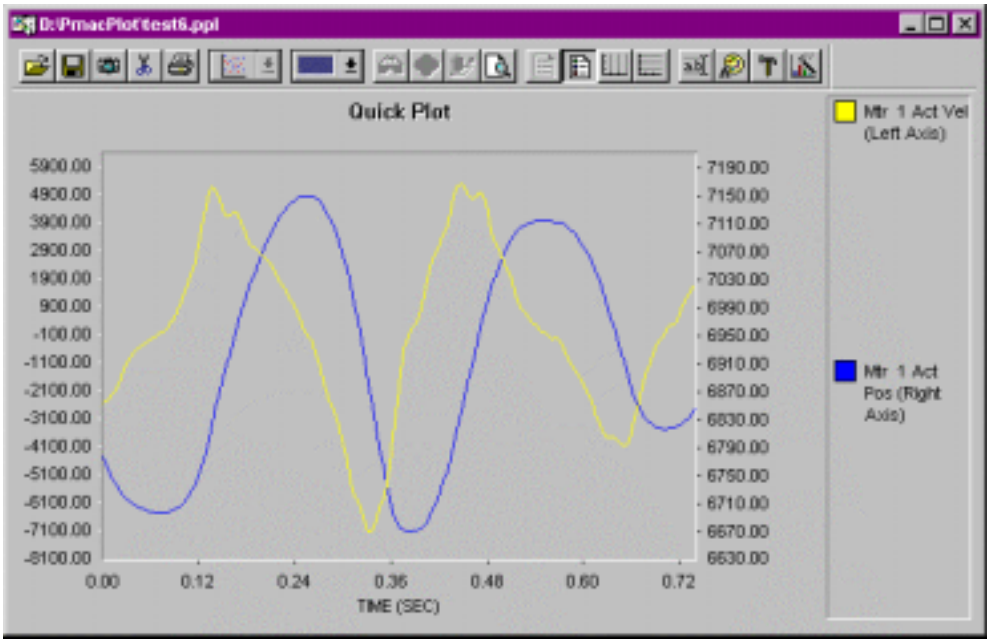
In addition to PPL files, now PMAC Plot can save the gathered data in both quick plot and detailed plot. Simply click **Gathered Data** from the Save menu and a save screen will open to save the file into a .Dgd file

Likewise, to upload a saved gathered data, choose **Open menu**, then choose **Gathered Data From File**. The saved data can be uploaded from similar window as above.

PLOT WINDOWS

Plot Window

Data from the quick or detail plot interfaces produce plot windows. This is where the desired data is displayed.



By default, the legend of each curve is displayed on the right side of the plot with color indicator corresponding to the color of the curve.

When the plot window displays, the toolbar is shown. Its features include:

Open Plot File - Open a saved plot file (PPL-File).

Save Plot File - The plot can be saved in three different formats: PmacPlot format (PPL-File), Excel format (tab delimited text file), and Matlab format (M-File).

Copy to Clipboard as Bitmap - Copy the plot to the clipboard as a bitmap image.

Copy Data to Clipboard as Text- Copy the data of the plot to the clipboard in a text file format.

Print – Print the current plot.

Change Colors - Change the background color of the plot by selecting a color and dropping it to the plot.

Zoom - Select a region in the plot to zoom in by left clicking the mouse, holding the button and stretching a rectangle box over the region. To see a region precisely, refer to the settings of the Scale of Change PMACPLOT Option.

Show or Hide Legends - Display the legend box or hide it.

Vertical Grid - Turn on/off the vertical grid.

Horizontal Grid - Turn on/off the horizontal grid.

Edit Titles - Create the titles for the plot.

Change Text Font - Change fonts for titles and legends.

Tools - Includes Data Editor features. See the following section.

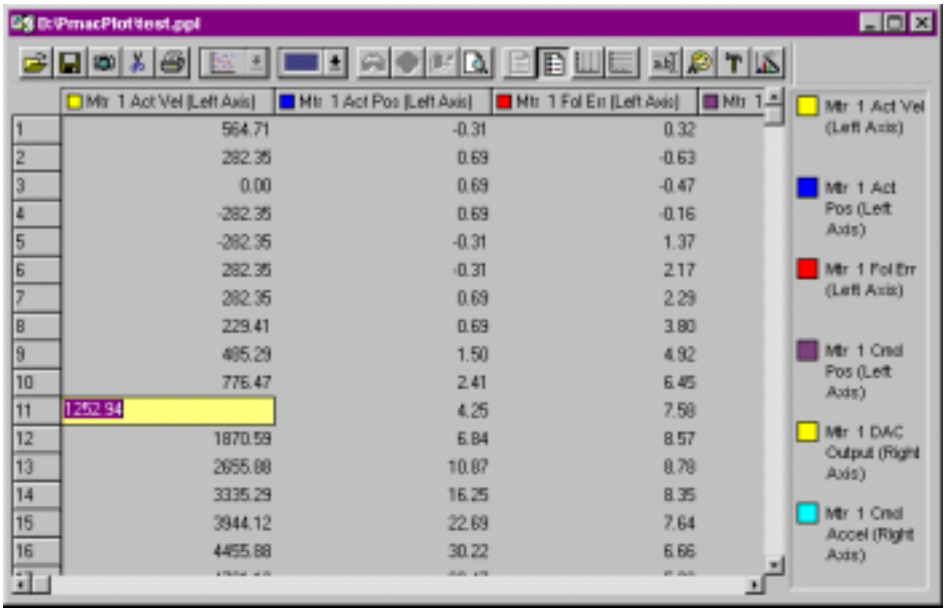
Change PmacPlot Option - Change the settings of Scale and Series. See the following section.

Tools

Data Editor

When the **Tools** button is clicked, a menu opens. Among the menu selections, Data Editor is the most useful feature. Data Editor is a switch. By default, the switch is set to off. If the switch is on (there is a check box before Data Editor), the current plot window will display all the data in columns. If the switch is off, the plot window shows the plot instead of the data.

With the Data Editor on, the values of a specific point in a particular curve can be changed.


D:\PmacPlot\test.ppl
Mtr 1 Act Vel (Left Axis)
Mtr 1 Act Pos (Left Axis)
Mtr 1 Fol Err (Left Axis)
Mtr 1
Mtr 1 Act Vel (Left Axis)
Mtr 1 Act Pos (Left Axis)
Mtr 1 Fol Err (Left Axis)
Mtr 1 Cmd Pos (Left Axis)
Mtr 1 DAC Output (Right Axis)
Mtr 1 Cmd Accel (Right Axis)

Change PmacPlot Option

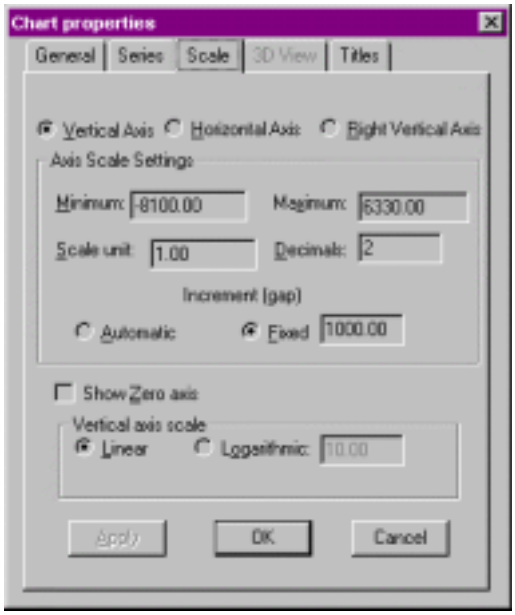
Use this button to change the scale of the horizontal, vertical, and right vertical axis. In addition, the settings of the Series and General can be changed to configure how the curves are displayed.

Scale

The Scale is a very useful feature to zoom in the area of interest precisely.

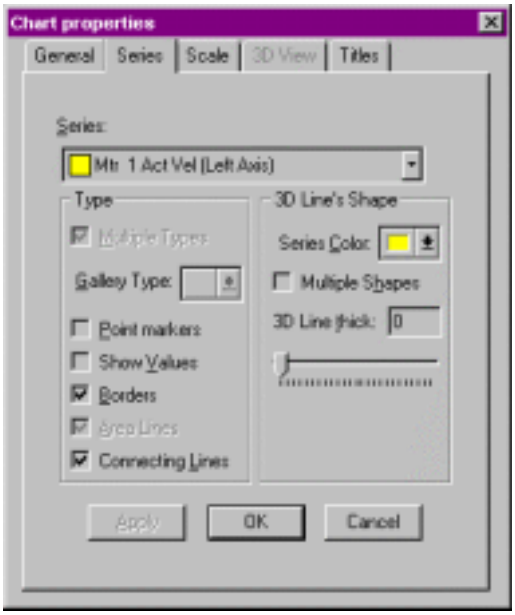
Example: To see the position change between 1 second and 1.2 second, select **Horizontal Axis** and enter **1** in the **Minimum** field and **1.2** in the **Maximum** field. Do the same things for both the vertical axis and right vertical axis to see a particular region on the plot.

The vertical axis values can be scaled using the selected logarithmic base.



Series

On the Series page the colors of curves can be changed. Also it can be decided to show all points with individual marker or a line connecting all points.



Save Plot Files

Save Plot Data into PPL-File

To save the current plot data and be able to reopen it from PmacPlot in the future, save the plot into a default PPL-format file by clicking the **Save Plot Files** icon on the toolbar.

The FFT conversion works for PPL, but it cannot convert PPL data saved in frequency domain back to time domain.

- If position, velocity, acceleration, jerk, following error or DAC/Current information were plotted and then saved in time domain, the FFT operation will generate frequency domain information.
- If position, velocity, acceleration, jerk, following error or DAC/Current information were plotted and then converted using FFT, and saved them in time domain, the FFT operation will not generate time domain information.

Save Plot Data into a Text File and Recreate the Plot from Microsoft Excel

PmacPlot can now save the plot data into a tab-delimited text file, which can be loaded into Microsoft Excel to recreate the plot for the report. To open the saved text file from Excel, select **File**, then **Open***;* select the text file name and be sure the Files of Type is Text Files *(*.prn, *.txt, *.csv),* and click **Open**. Excel will launch the Text Import Wizard. At step 1 of the wizard, select **Delimited at Original Data Type**. At step 2, select **Tab as Delimiter**. Then click **Finish** at step 3.

Note:

The data of the horizontal axis (usually it is Time) will appear at the first column. The legends of the series will appear at the first row.

After the file is successfully loaded, use Excel to regenerate the plot from the data.

Save Plot Data into a Matlab File (M-file)

The PmacPlot can also save the data into M-file, which can run in Matlab. In other words, all the data can be exported to Matlab for further mathematical analysis.

If the data is saved into an M-file and run it in Matlab, the following texts will display in the Matlab Window:

```
*************************************************************
*   This file is generated by Delta Tau Data System's PmacPlot Software
*   If you have any problem about this file,
*   Please contact Delta Tau at (818) 998-2095
*   The following column vectors are created:
*   x_v : TIME (SEC)(X-Axis)
*   y_0 : Mtr  1 Act Vel (Left Axis)
*   y_1 : Mtr  1 Act Pos (Right Axis)
*   Use the above vectors to generate your plots
*   Ex. Plot(x_v, y_0)
*************************************************************
```

The information displayed will show the variable names for those created vectors. Usually, the data of the horizontal axis will be stored in the vector x_v, and the data of the vertical axis and right vertical axis will be stored in the vectors y_*x* , where *x* is an index number.

FFT (Fast Fourier Transform)

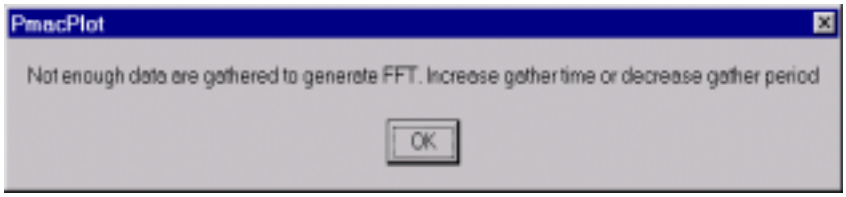
This feature was added n version 1.19 and may be used to translate time domain data to frequency domain data. The algorithm used in the conversion is called Danielson-Lanczos Transformation and may be found from the book Numerical Recipe. This algorithm is based on the premise that the number of data points is a power of 2 and zero padding is done to ensure the property.

Frequency Range

It is important to note that setting the gather period (I19) and servo period (I10) will affect the frequency range of the FFT.

- If only the low frequency range data are relevant, increase the gather period. For instance, if I10 is set to the default value (3713991) and gather period to 10 (I19=25), the resulting frequency range is 0 to 45 Hz.
- If higher frequency range data are needed, decrease the gather period. For instance, if I10 is set to the default value (3713991) and gather period to 10 (I19=5), the resulting frequency range is 0 to 225 Hz.

In addition, a sufficient number of the data points are needed to ensure data integrity. When I19 is set high, make sure that data gathering is done for sufficient time so that the number of data points are adequate to perform FFT. If not enough points are gathered for FFT, an error message will appear.



Logarithmic Plot

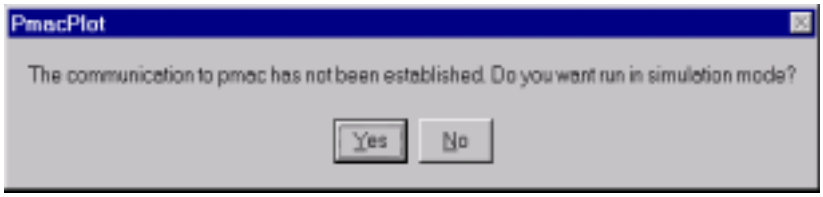
Choose whether the FFT will be plotted in the Cartesian or the logarithmic scale. Using logarithmic scale may help to identify the finer detail in certain cases.

PMAC Plot 1.19 has Simulated Mode operation capability, meaning it no longer requires a PMAC to be run on Windows 95/98/NT. The previously saved gathered data may be loaded in Qgd, Dgd or PPL formats and the gathered data may be processed and plotted.

USING SIMULATED MODE

The following steps will enable simulated mode:

1. First, make sure the PMAC drivers are unloaded in the PC. Click the **Unload** button from the MotionExe.exe applet in Windows NT. In Windows 95/98, unplugging PMAC will ensure that no drivers for PMAC are loaded.
2. Start the PMAC Plot 1.19. The following message will be displayed.



3. Click **Yes** to start the simulation mode. Click **No** to end the program.
4. Load the gathered data files or PPL files.
5. Now it is ready to plot.